Recent Advances in Cryogenic Optics Technology for Space Infrared Telescope and Interferometer Systems

Daniel R. Coulter and Steven A. Macenka
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA
USA

Abstract

In this paper we will describe recent advances in the development of optical systems for future cryogenic space infrared telescope and interferometer applications with emphasis on beryllium and silicon carbide optics. New material formulations and advanced processing and manufacturing techniques are enabling the development of large, very low mass, high performance cryogenic optics. The design, manufacturing and cryogenic testing of several recently developed mirrors and optical assemblies will be discussed. Specifically interferometric test results obtained at 77 K and <5K, for two HIP beryllium optics, including a 50cm diameter planoconcave spherical mirror and an ultralightweight 87cm diameter hyperbolic single arch mirror will be presented along with similar results on a 50cm diameter, spherical, closed back, reaction bonded silicon carbide mirror. All of these mirrors show small cryogenic distortions and essentially no measurable "hysteresis" or temporal instability. In addition, the design, manufacturing and preliminary test results on the Infrared Telescope Technology Wide (ITTT), an 85cm clear aperture, 35kg, all beryllium telescope, diffraction limited at 6.5 microns will be described. The ITTT is a technology prototype for the SIRTF telescope. Finally, a state-of-the-art cryo-optical test facility developed at JPL will be described, including, the manufacturing and testing of a 90cm diameter silicon carbide autocollimation flat for cryogenic tests of infrared telescope assemblies.